FINAL
FIELD SAMPLING PLAN FOR AREA 5 (J-1 RANGE)

OF THE
CAMP EDWARDS IMPACT AREA GROUNDWATER QUALITY STUDY

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

Prepared for

NATIONAL GUARD BUREAU
ARLINGTON, VIRGINIA

Prepared by

OGDEN ENVIRONMENTAL AND ENERGY SERVICES
239 Littleton Road, Suite 1B
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DISCLAIMER:

This document has been prepared pursuant to a government administrative order (U.S. EPA Region I SDWA Docket No. I-97-1019) and is subject to approval by the U.S. Environmental Protection Agency. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency.

A.12 Area 5 Field Sampling Plan

A.12.1 Background and Focal Area(s)

Area 5 (the J-1 range) is located along one mile of Tank Alley between Chadwick Road and Greenway Road as illustrated in Figures A.12-1 and A.12-2. Area 5 consists of a 2000-meter range, a 1000-meter range, a 150-meter range, and a 100-meter range based on a schematic diagram of proposed activities at the J-1 ranges, as illustrated in Figure A.12-3. The 2000-meter range ends in the Impact Area at a location that has been identified as a separate area of concern. This location, Area 4, has a separate Field Sampling Plan that describes investigations under the Impact Area Groundwater Study.

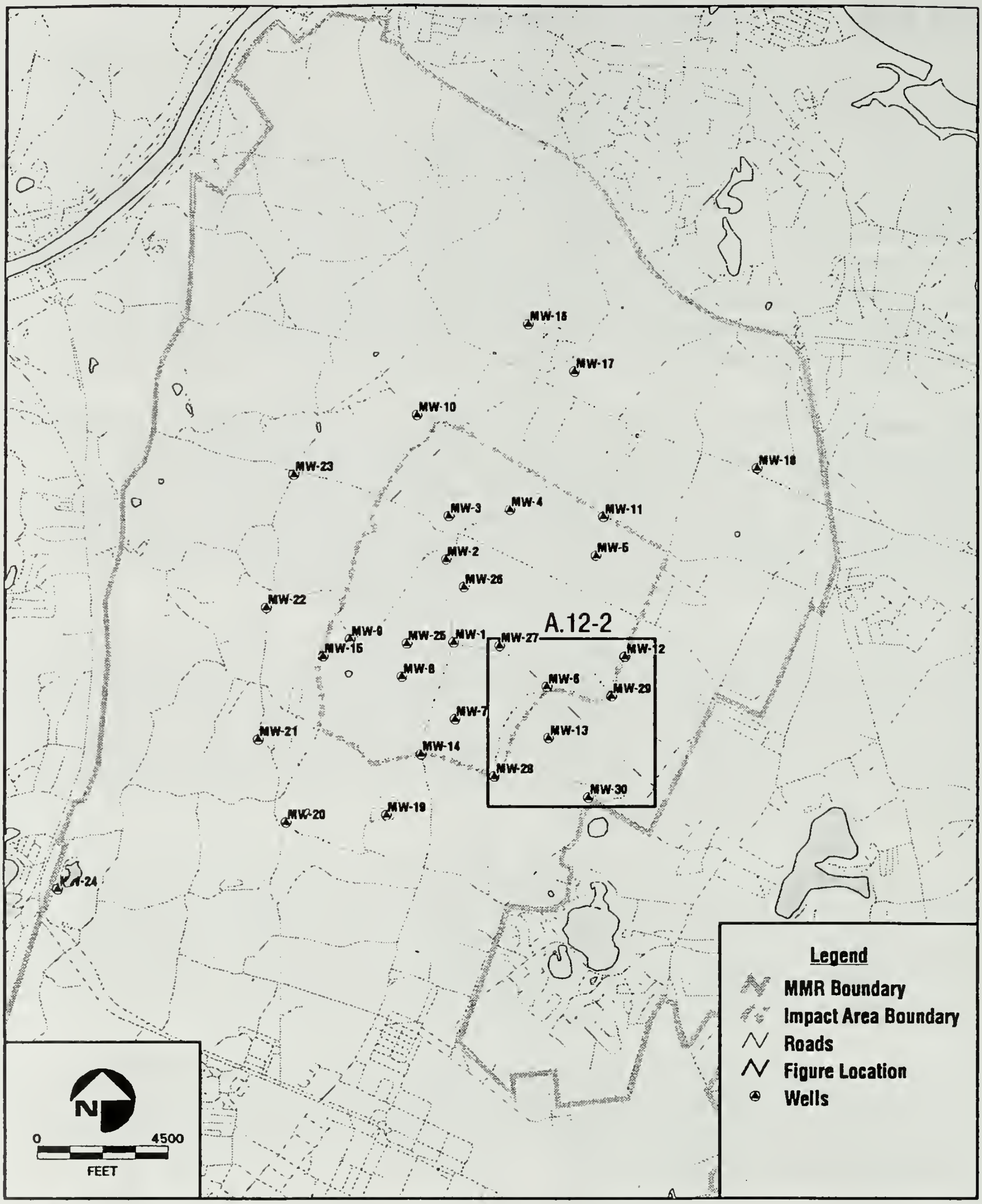
The schematic in Figure A.12-3 shows two bunkers and four storage buildings located at the southeastern end of the J-1 range, none of which are visible today. All other structures, mounds, and borrow areas shown on the schematic are still visible today, although the extension of the tunnel barriers shown on the schematic does not appear to have occurred. Features currently visible on the three shorter ranges are illustrated in Figures A.12-4 and A.12-5 and the accompanying photographs.

The 1000-meter range appears to extend from the southeast end of the J-1 range through two tunnel barriers, which each consist of 8-foot diameter concrete pipe passing through a 40- to 60-foot high earth mound (Figure A.12-5, Photographs G and H). Steel plates are present at the entrances to these tunnel barriers, and may have been used as targets. The 1000-meter range terminates at steel plate targets laid on a 45-foot high earthen backstop (Figure A.12-4, Photographs C and D).

The 150-meter range extends from near the instrumentation bunker to a 30-foot high earth mound to the northwest (Figure A.12-4, Photograph F). A steel "burn kettle" (Photograph B) of a type reportedly used for munitions disposal by burning is located near the bunker (Photograph A). Several low earth berms are located north of the 150-meter backstop (Photograph E); their function is unknown at this time.

The 100-meter range extends from the southeast end of the J-1 range to the southeast tunnel barrier mound (Figure A.12-5). This mound has a steel plate inclined at a 10-20 degree angle downward into the mound (Photograph H), which may have been used as a target for the 100-meter range.

Two pits containing munitions are located on the southwest side of Tank Alley in the vicinity of the 1000-meter range (Figure A.12-4). The northern location is directly across Tank Alley less than 100 feet from the 150-meter backstop. This location has steel plate sides, and a steel plate, which may have been used for a lid, is located nearby



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MMR - Area 5 Vicinity Map

FIGURE

A.12-1

/net/palm/oahu/mmrdata/mmr/spatial/ogden/plots/figures/area5_vmap.aml

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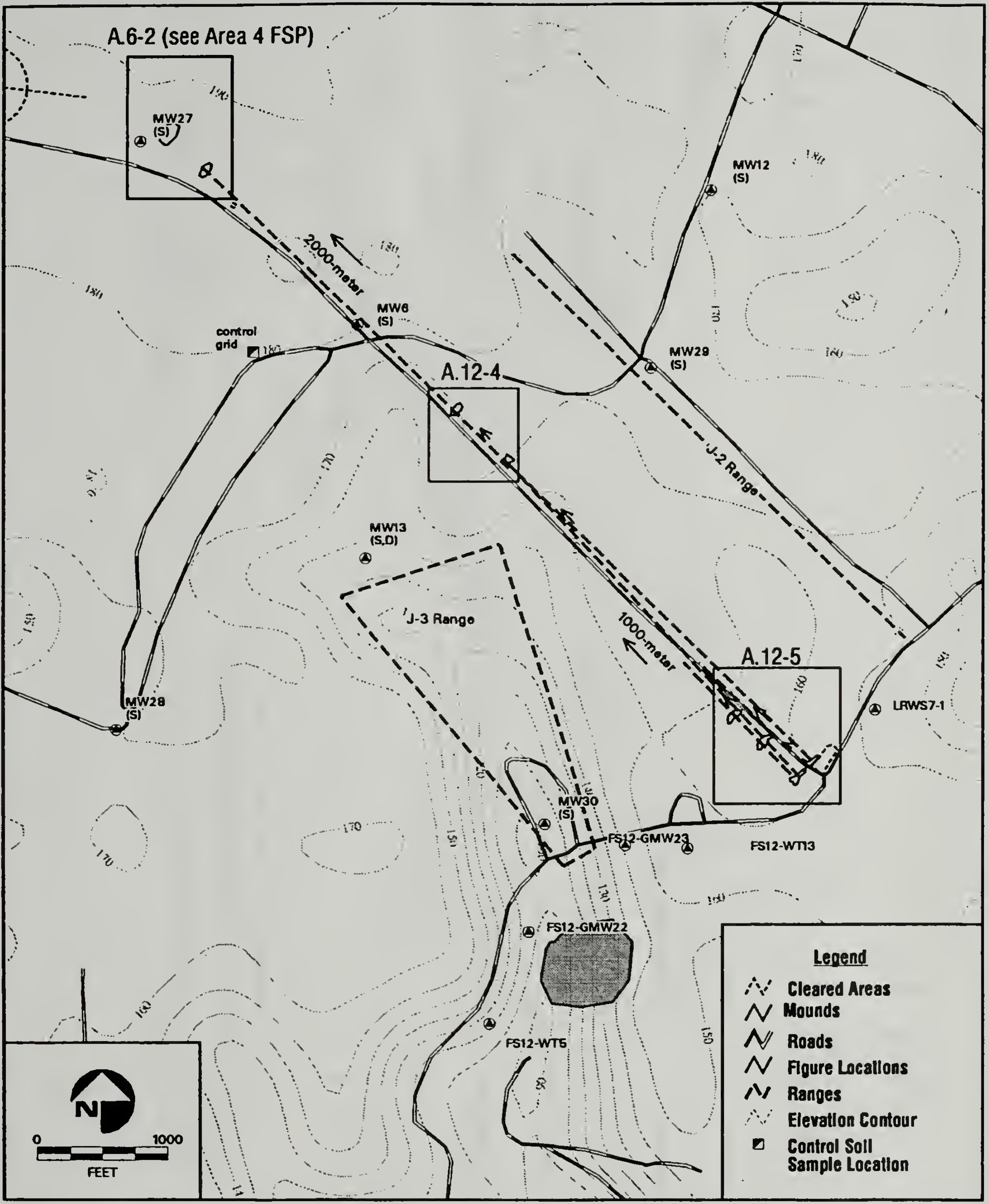

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Area 5 Sampling Points

FIGURE

A.12-2

/net/palau/oaba/mmrdata/mmr/spatial/ogden/plots/figures/area5_fig12-2.aml

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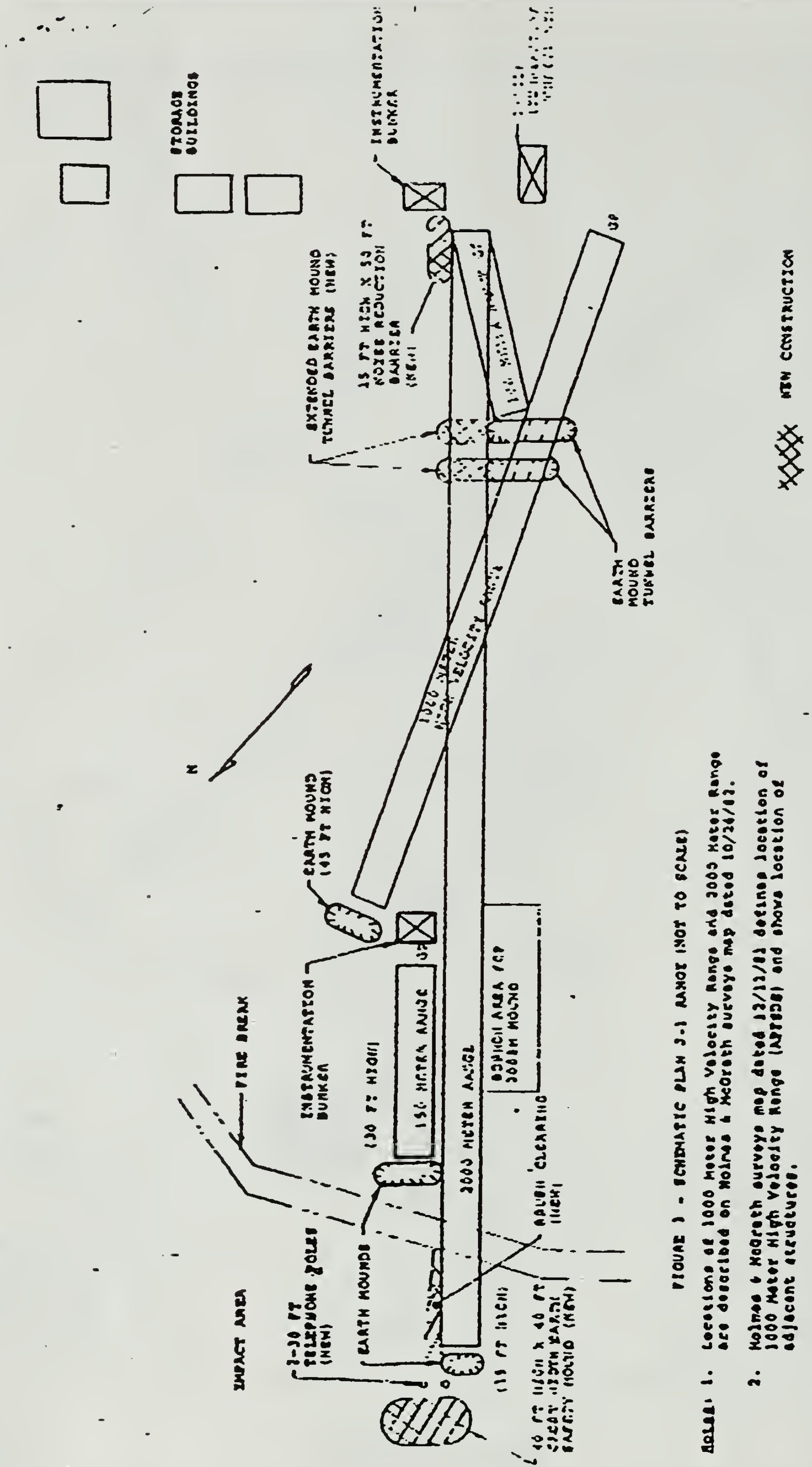
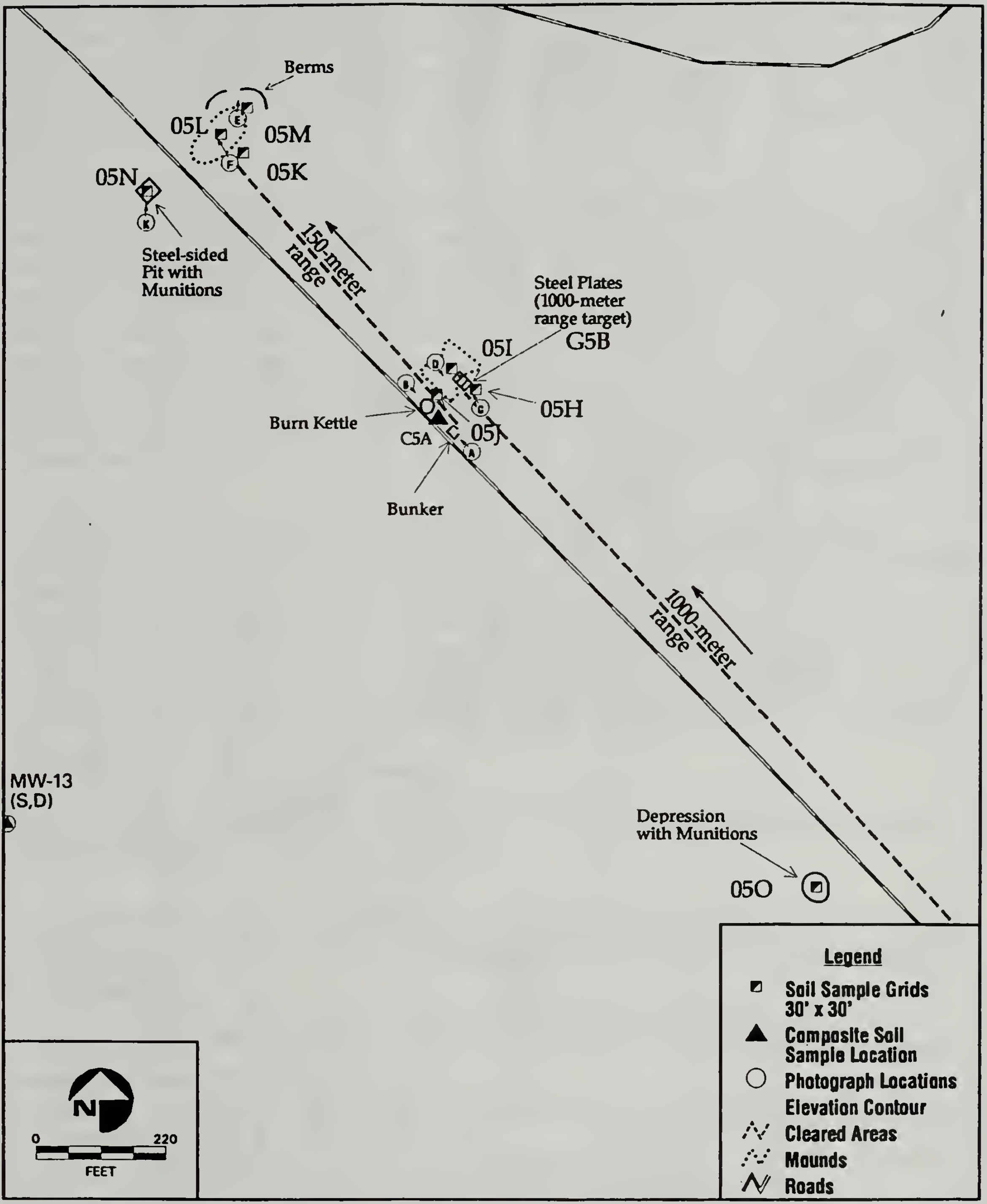

STORAGE BUILDINGS
N
IMPACT AREA
FIRE BREAK
3-30 FT TELEPHONE POLES (NEW)
EARTH MOUNDS
(30 FT HIGH)
150 METER RANGE
INSTRUMENTATION BUNKER
EARTH MOUND (45 FT HIGH)
2000 METER RANGE
(15 FT HIGH)
40 FT HIGH X 40 FT CREST WIDTH EARTH SAFETY MOUND (NEW)
BRUSH CLEARING (NEW)
BORROW AREA FOR 2000M MOUND
1000 METER HIGH VELOCITY RANGE
EXTENDED EARTH MOUND TUNNEL BARRIERS (NEW)
15 FT HIGH X 55 FT NOISE REDUCTION BARRIER (NEW)
INSTRUMENTATION BUNKER
EARTH MOUND TUNNEL BARRIERS
UP
NEW CONSTRUCTION

FIGURE 3 - SCHEMATIC PLAN J-1 RANGE (NOT TO SCALE)

Notes: 1. Locations of 1000 Meter High Velocity Range and 2000 Meter Range are described on Holmes & McGrath surveys map dated 10/26/82.

2. Holmes & McGrath surveys map dated 12/13/81 defines location of 1000 Meter High Velocity Range (AP7638) and shows location of adjacent structures.

Figure A.12-3. Schematic Diagram of Proposed J-1 Range Modifications.



FIGURE

A.12-4

Area 5 Sampling Points

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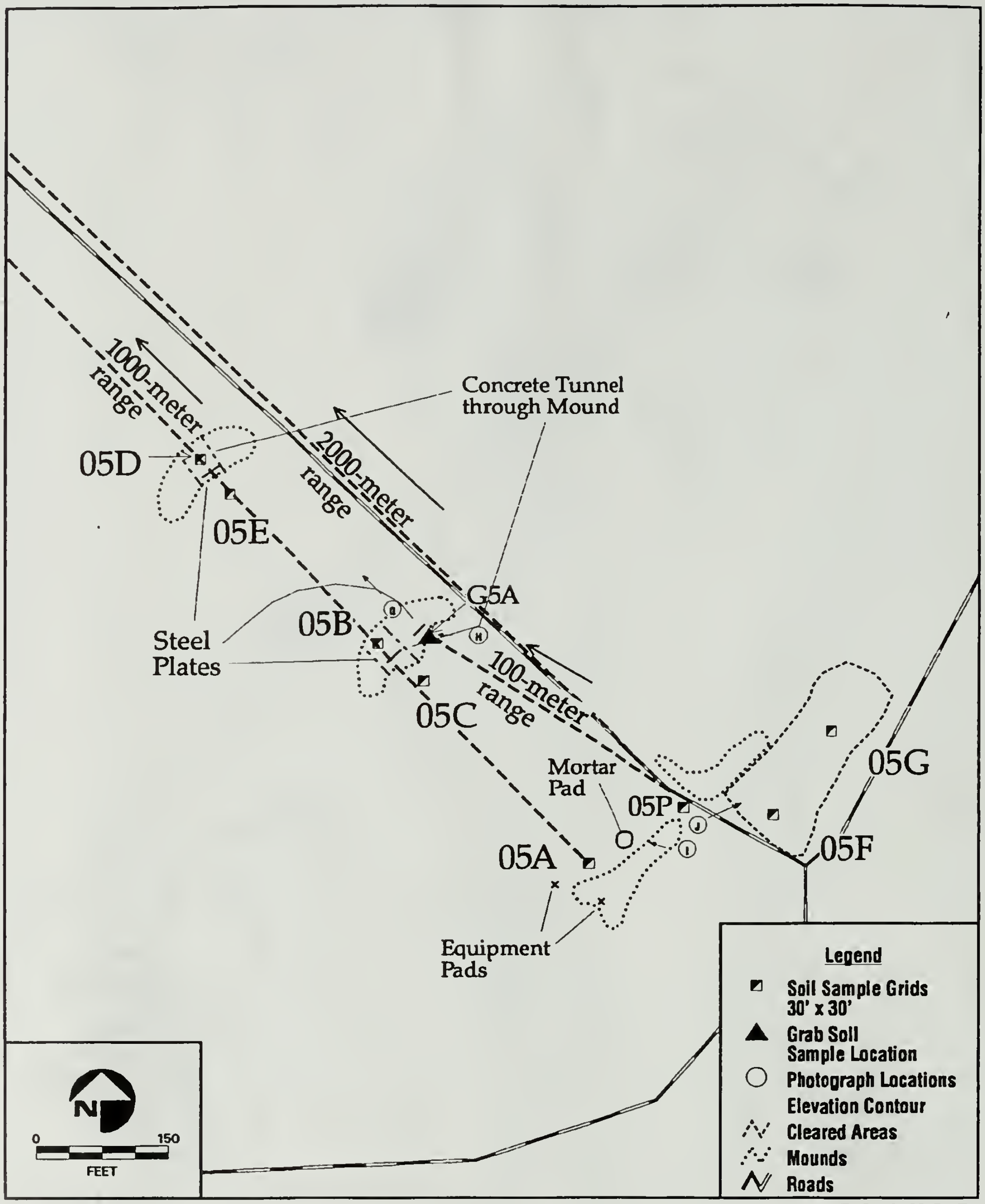

OGDEN

Area 5 Sampling Points

FIGURE

A.12-5

/net/palm/oahu/mmrdata/mmr/spatial/ogden/plots/figures/area5.aml

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(Photograph K). This pit measures approximately 8 feet by 8 feet, and its depth is unknown. The southern location appears to be a depression about 3 feet in diameter, and one foot deep. This pit is located approximately 800 feet southeast of the 1000-meter target, along Tank Alley. There is no evidence of a lining at this pit. The uses of these pits are unknown.

There is a cleared area and scattered building debris at the southeast end of the J-1 range that suggest that the storage buildings and bunkers shown on the schematic in this area were demolished (Figure A.12-5, Photograph J). The former use of these structures is unknown. Ten-foot high earth mounds are located on both sides of Tank Alley in this area. The southern mound, which is not shown on the schematic, contains building debris and may have been constructed during demolition (Photograph I). Equipment and mortar platforms are located along the northwest side of this mound, in the area where the schematic shows the gun position for the 1000-meter range. The northern mound appears to have been constructed as a noise reduction barrier, based on the schematic.

Based on interviews, depleted uranium (DU) rounds may have been used by R&D contractors in the J-1 range in the past because DU is extremely dense and provides high penetration. According to U.S. Army records, several prefabricated DU liners were loaded and assembled at the J-3 range located nearby, but were shipped to another site without firing at MMR. Depleted uranium contains 99.7% U_{238}, primarily an alpha emitter, and 0.3% U_{235}, a naturally occurring or enriched high-energy gamma emitter. If DU rounds were used in the past there may be alpha or gamma radiation present in the area.

Eleven focal areas were identified for Area 5 based on the historical information and current features:

- a 130 x 70-foot, 30-foot high earthen backstop mound and adjacent berms at the northwest end of the 150-meter range that is shown in Figure A.12-4 (estimated area = 0.3 acre);
- a 100 x 100-foot, 45-foot high earthen backstop mound with steel plates on the southeast side at the northwest end of the 1000-meter range that is shown in Figure A.12-4 (estimated area = 0.2 acre);
- the suspected firing position for the 150-meter range near the bunker shown in Figure A.12-4 (estimated area = 0.1 acre);
- a burn kettle near the 150-meter range that is shown in Figure A.12-4;
- a 8 x 8 foot steel-lined pit containing munitions, located southwest of the 150-meter backstop as shown in Figure A.12-4;
- a 3-foot diameter depression containing munitions, located on the southwest side of Tank Alley within the 1,000-meter range, as shown in Figure A.12-4;

- a 100 x 70-foot, 40-foot high earthen mound tunnel barrier in the 1000-meter range that is shown in Figure A.12-5 (estimated area = 0.2 acre);
- a 135 x 75-foot, 60-foot high earthen mound tunnel barrier in the 1000-meter range that is shown in Figure A.12-5 (estimated area = 0.2 acre), which also contains a 10 x 10-foot steel plate target for the 100-meter range;
- the suspected firing position for the 1,000-meter range on the northwest side of a 170 x 35 foot, 10-foot high earthen mound and equipment pads that are shown in Figure A.12-5 (estimated area = 0.1 acre);
- a 0.3-acre cleared area at the southeast end of Tank Alley with visible scattered building debris where two bunkers and former buildings appear on the site schematic; and
- the suspected firing position for the 100-meter and 2,000-meter ranges at the southeast end of Tank Alley (estimated area =0.1 acre).

The mound on the north side of Tank Alley at the east end is not considered to be a separate focal area based on the identification of its use as a noise barrier in the schematic figure. This mound is adjacent to the suspected firing position for the 100-meter and 2,000-meter ranges, which is identified as a focal area.

A.12.2 Sampling & Analysis Methods

Area 5 sampling will include surface soil at each focal area based on the potential release of munitions-related contaminants at ground surface from target practice and operations at the former buildings. All surface soil will be collected in locations undisturbed by excavation or road building activities. The soil beneath the two pits containing munitions will be sampled after removal of munitions and debris. Details regarding sample locations are discussed below under “Hand Auger Sampling”.

Approximately five monitoring wells are located in the vicinity of Area 5, as indicated in Figure A.12-1. Groundwater sampling and analysis at these locations is described in the Final FSPs for Area 4, Barber Rig Drilling, and Rotosonic Rig Drilling. EPA may require additional groundwater sampling based on the results of this study.

Sample collection will be consistent with MMR SOPs, the Ogden Health and Safety Guidelines, Attachment A: Field Guide to High Explosives, and the EPA Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities (October 31, 1996). EPA Method 8330 will be used to analyze all soil samples from Area 5 with detectable levels of explosives by the colorimetric analysis. **All borings and hand auger locations in Area 5 are subject to UXO clearance requirements.**

Radiological Survey

A radiological survey of soil samples will be conducted at all soil sampling locations in the J-1 ranges based on their potential to contain alpha and beta-gamma radiation. All three types of radiation can be detected with portable radiation instruments, which will be used during soil sampling activities. Two instruments will be used for the survey; a Ludlum Model 3 ratemeter attached to a Ludlum Model 44-9 probe to detect beta-gamma radiation, and a Ludlum Model 3 ratemeter attached to a Ludlum Model 43-65 probe to detect alpha radiation. The minimum sensitivity of these instruments is approximately one count per minute (cpm), or 2.4 disintegrations per minute (dpm) using a measured efficiency of 41% for the detector. By comparison, DOE Order 5480.11 specifies an occupational protection level of 5,000 dpm/100 cm^2 for alpha radiation from U_{235} or U_{238}.

The survey will be conducted according to the following procedures:

1. the portable survey meter will be calibrated at annual intervals and will be properly labeled with the calibration date;
2. the portable survey meters will be checked for response with an appropriate radiation source at least hourly during surveys;
3. background radiation levels will be determined at least daily prior to sampling activities at the field office at 1005 South Inner Road;
4. the response check will be repeated periodically during the survey;
5. all readings will be taken within 1cm of the soil sample;
6. all results will be recorded in counts per minute (cpm).

Any reading above background will require that sampling be discontinued and sampling personnel move away from the suspected radiation source until the meters register background. Sampling personnel will notify the Field Program Manager immediately of any exceedance of background.

Hand Auger Sampling

A representative portion of each focal area will be sampled, as indicated in Figures A.12-4 and A.12-5. Following is the distribution of soil sampling locations in each of the eleven focal areas:

- Each of the four mound focal areas that are located within or at the end of a range will sampled with one 30x30-foot grid on the top (05B, 05D, 05I, and 05L) and one 30x30-foot grid at the base of the side which faces the range firing location (05C, 05E, 05H, and 05K). Because these mounds acted as backstops or tunnel barriers for targets, these locations should be representatives of any impact that firing activities may have had on the mounds and their surroundings.

A grab sample (G5B) will be collected using a spoon or scoop from soil between the rows of steel plates on the backstop for the 1000-meter range. A grab sample (G5A) will be collected using a spoon or scoop from soil within the hole beneath the target steel plate at the end of the 100-meter range. A 30x30-foot grid (05M) will be located near the berms to the north of the 150-meter range backstop. The use of these berms is unknown.

- The suspected firing position for the 1000-meter range will be sampled with one 30x30-foot grid (05A) located at its base between the mortar and equipment platforms. This location represents any impact firing activities may have had to the mound and its surrounding area, because it is adjacent to the firing position.

- The location of the former buildings and bunkers will be sampled with two 30x30-foot grids (05F and 05G) placed in areas with building debris. The composites from these two grids will be composited into a single sample.

- The suspected firing position for the 150-meter range, near the instrumentation bunker at the southeast end of this range, will be sampled with a 30x30-foot grid (05J).

- The suspected firing position for the 100-meter and 2,000-meter ranges, at the east end of Tank Alley, will be sampled with a 30x30-foot grid (05P).

- Four grab samples will be collected by hand auger and composited to a single sample (C5A) from around the burn kettle near the 150-meter range. The samples will be from all four sides within one foot of the kettle.

- A 30x30-foot grid will be centered on each of the two pits (05N and 05O) containing munitions. The 10-foot interval grid point(s) falling on the pit itself, or in the case of the steel-lined pit within 6 feet of the steel walls, will not be sampled. Note that 6 feet from the steel walls is the minimum distance at which UXO clearance can be performed with magnetometers. The remaining grid points will be sampled and composited.

  Soil beneath the pits will be sampled after munitions and other debris have been removed. Soil that is removed from the pits will be stockpiled on and covered with plastic sheeting to prevent precipitation runoff. A grab sample (G5C, G5E) will be collected from the bottom of each excavation or beneath any liner, if present, and from the soil stockpile removed from each pit (G5D, G5F).

In addition to these focal areas, a "local background" sample will be obtained from an area on Chadwick Road that is not suspected to have been impacted by J-1 Range activities. This location is shown in Figure A.12-2 ("control grid").

Each soil boring grid will consist of nine samples spaced ten feet apart as illustrated in Figure A.12-6, collected using a hand auger. The following protocol will be followed for hand augering:

1. a 0-6" soil sample will be collected from each of the nine sample points in a grid;
2. soil from each sample point will be placed in a headspace jar;
3. the remaining soil from each of the nine sample points will be composited in accordance with Section 8.1 of the EPA Standard Guide and Attachment A of this FSP; headspace measurements will be collected from each of the nine 0-6" samples and recorded in the space provided on the hand auger log;
4. a VOC grab sample will be collected from one sample point based on the following priority of observations: 1)highest response on the FID, 2) visual signs of contamination, 3) the central grid location (a fresh soil sample will be collected adjacent to the sample point). The VOC sample will be collected from within one-foot of the full screening sample;
5. the 0-6" composite sample will be submitted for explosives, inorganics, and other analytes;
6. when the analytical results from the 0-6" sample are available, an 18-24" sample will be collected and composited as described above for explosives and inorganics. Any other analytes (except VOC) that are detected in the 0-6" sample will be analyzed;
7. an 18-24" sample will be selected for VOC analysis based on screening with an FID as described in steps 1-5 above.

The grab samples collected from beneath the steel target plate on the 100-meter range, from between the steel target plates on the 1000-meter range, and from the excavated soils and bottom of each pit will be submitted for analysis of all target compounds.

Table A.12-1 lists sample numbers and analytical requirements for the areas to be investigated.

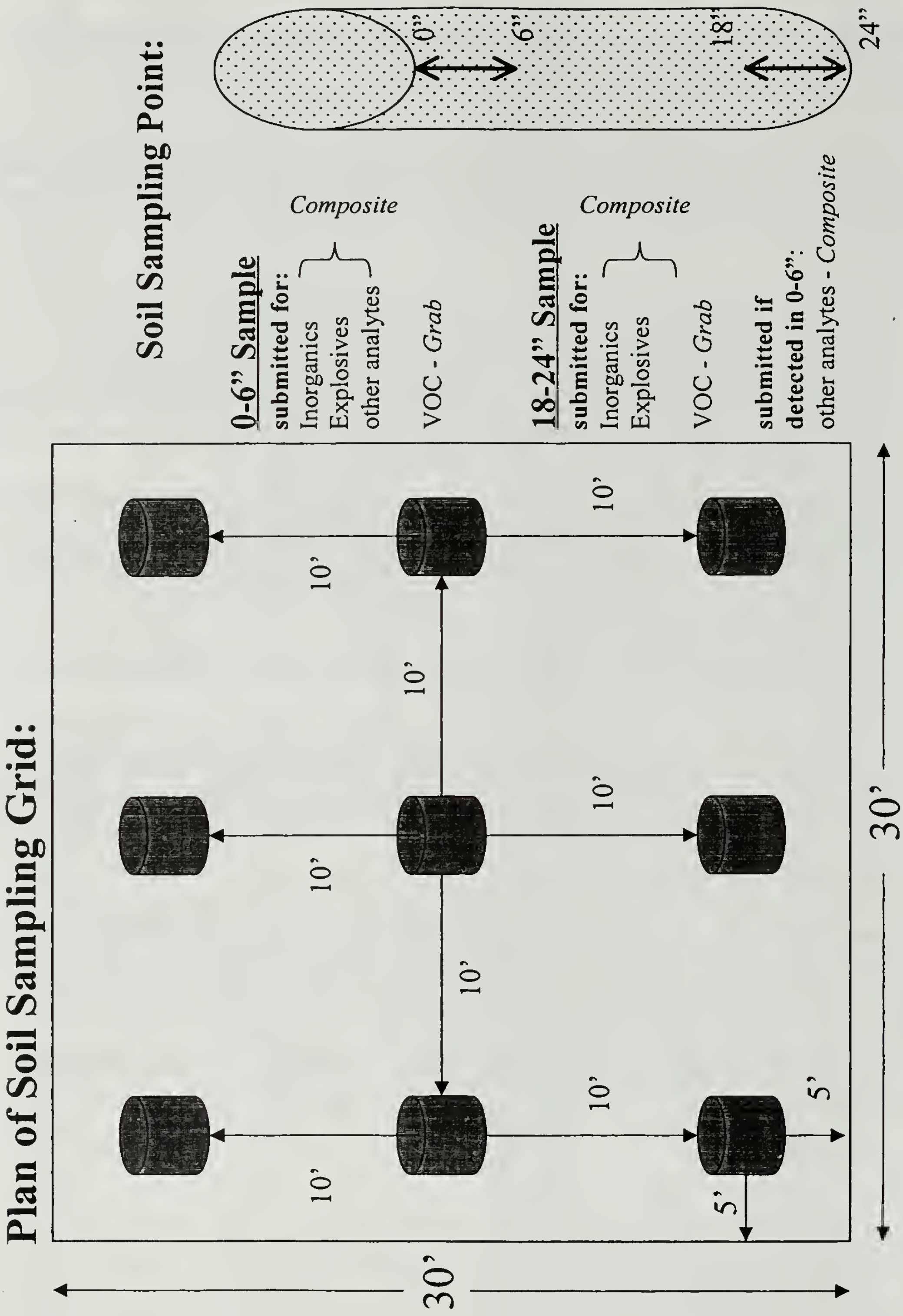


Figure A.12-6 Arrangement of Soil Sampling Grid

Table A.12-1. Samples to be collected from Area 5.

MMR Soil Samples from Hand Auger Grids						Parameters:	Explosives (colorimetric)	Explosives (EPA 8330)	Inorganics	Other Analytes:	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
Area	Grid	Depth	Type	MMR ID	EPA/Ogden ID	Cont:	8oz	8oz	8oz		4 oz.	8 oz.			4 oz.*	
5	05A	0-6	grab	71BS05AXAX01XA	B05AAA						X					
			comp	71BS05AXAX01XA	B05AAA		X		X			X	X	X	X	X
		18-24	grab	71BS05AXBX01XA	B05ABA						#					
			comp	71BS05AXBX01XA	B05ABA		O		O			#	#	#	#	#
	05B	0-6	grab	71BS05BXAX01XA	B05BAA						X					
			comp	71BS05BXAX01XA	B05BAA		X		X			X	X	X	X	X
		18-24	grab	71BS05BXBX01XA	B05BBA						#					
			comp	71BS05BXBX01XA	B05BBA		O		O			#	#	#	#	#
	05C	0-6	grab	71BS05CXAX01XA	B05CAA						X					
			comp	71BS05CXAX01XA	B05CAA		X		X			X	X	X	X	X
		18-24	grab	71BS05CXBX01XA	B05CBA						#					
			comp	71BS05CXBX01XA	B05CBA		O		O			#	#	#	#	#
	05D	0-6	grab	71BS05DXAX01XA	B05DAA						X					
			comp	71BS05DXAX01XA	B05DAA		X		X			X	X	X	X	X
		18-24	grab	71BS05DXBX01XA	B05DBA						#					
			comp	71BS05DXBX01XA	B05DBA		O		O			#	#	#	#	#
	05E	0-6	grab	71BS05EXAX01XA	B05EAA						X					
			comp	71BS05EXAX01XA	B05EAA		X		X			X	X	X	X	X
		18-24	grab	71BS05EXBX01XA	B05EBA						#					
			comp	71BS05EXBX01XA	B05EBA		O		O			#	#	#	#	#
	05F	0-6	grab	71BS05FXAX01XA	B05FAA						X					
			comp	71BS05FXAX01XA	B05FAA		X		X			X	X	X	X	X
		18-24	grab	71BS05FXBX01XA	B05FBA						#					
			comp	71BS05FXBX01XA	B05FBA		O		O			#	#	#	#	#
	05G	0-6	grab	71BS05GXAX01XA	B05GAA						X					
			comp	71BS05GXAX01XA	B05GAA		X		X			X	X	X	X	X
		18-24	grab	71BS05GXBX01XA	B05GBA						#					
			comp	71BS05GXBX01XA	B05GBA		O		O			#	#	#	#	#
	05H	0-6	grab	71BS05HXAX01XA	B05HAA						X					
			comp	71BS05HXAX01XA	B05HAA		X		X			X	X	X	X	X
		18-24	grab	71BS05HXBX01XA	B05HBA						#					
			comp	71BS05HXBX01XA	B05HBA		O		O			#	#	#	#	#
	05I	0-6	grab	71BS05IXAX01XA	B05IAA						X					
			comp	71BS05IXAX01XA	B05IAA		X		X			X	X	X	X	X
		18-24	grab	71BS05IXBX01XA	B05IBA						#					
			comp	71BS05IXBX01XA	B05IBA		O		O			#	#	#	#	#
	05J	0-6	grab	71BS05JXAX01XA	B05JAA						X					
			comp	71BS05JXAX01XA	B05JAA		X		X			X	X	X	X	X
		18-24	grab	71BS05JXBX01XA	B05JBA						#					
			comp	71BS05JXBX01XA	B05JBA		O		O			#	#	#	#	#

Table A.12-1, continued. Samples to be collected from Area 5.

MMR Soil Samples from Hand Auger Grids						Parameters:	Explosives (colorimetric)	Explosives (EPA 8330)	Inorganics	Other Analytes:	VOC	SVOC	PCB/Pest.	Herbicide	EDB	MTBE
Area	Grid	Depth	Type	MMR ID	EPA/Ogden ID	Cont:	8oz	8oz	8oz		4 oz.	8 oz.			4 oz.*	
	05K	0-6	grab	71BS05KXAX01XA	B05KAA						X					
			comp	71BS05KXAX01XA	B05KAA		X		X			X	X	X	X	X
		18-24	grab	71BS05KXBX01XA	B05KBA						#					
			comp	71BS05KXBX01XA	B05KBA		O		O			#	#	#	#	#
	05L	0-6	grab	71BS05LXAX01XA	B05LAA						X					
			comp	71BS05LXAX01XA	B05LAA		X		X			X	X	X	X	X
		18-24	grab	71BS05LXBX01XA	B05LBA						#					
			comp	71BS05LXBX01XA	B05LBA		O		O			#	#	#	#	#
	05M	0-6	grab	71BS05MXAX01XA	B05MAA						X					
			comp	71BS05MXAX01XA	B05MAA		X		X			X	X	X	X	X
		18-24	grab	71BS05MXBX01XA	B05MBA						#					
			comp	71BS05MXBX01XA	B05MBA		O		O			#	#	#	#	#
	05N	0-6	grab	71BS05NXAX01XA	B05NAA						X					
			comp	71BS05NXAX01XA	B05NAA		X		X			X	X	X	X	X
		18-24	grab	71BS05NXBX01XA	B05NBA						#					
			comp	718S05NXBX01XA	B05NBA		O		O			#	#	#	#	#
	05O	0-6	grab	71BS05OXAX01XA	B05OAA						X					
			comp	71BS05OXAX01XA	B05OAA		X		X			X	X	X	X	X
		18-24	grab	71BS05OXBX01XA	B05OBA						#					
			comp	71BS05OXBX01XA	B05OBA		O		O			#	#	#	#	#
	05P	0-6	grab	71BS05PXAX01XA	B05PAA						X					
			comp	71BS05PXAX01XA	B05PAA		X		X			X	X	X	X	X
		18-24	grab	71BS05PXBX01XA	B05PBA						#					
			comp	71BS05PXBX01XA	B05PBA		O		O			#	#	#	#	#
	05Q	0-6	grab	71BS05QXAX01XA	B05QAA						X					
			comp	71BS05QXAX01XA	B05QAA		X		X			X	X	X	X	X
		18-24	grab	71BS05QXBX01XA	B05QBA						#					
			comp	71BS05QXBX01XA	B05QBA		O		O			#	#	#	#	#
Grab sample from 100-m target inlet:																
	G5A	0-6	grab	71BSG5AXAX01XA	BG5AAA			X	X		X	X	X	X	X	X
Grab sample from 1000-m targets:																
	G5B	0-6	grab	71BSG5BXAX01XA	BG5BAA			X	X		X	X	X	X	X	X
Grab samples from steel-sided pit:																
	G5C	bottom	grab	71BSG5CXAX01XA	BG5CAA			X	X		X	X	X	X	X	X
	G5D	exc. soil	grab	71BSG5DXAX01XA	BG5DAA			X	X		X	X	X	X	X	X
Grab samples from depression:																
	G5E	bottom	grab	71BSG5EXAX01XA	BG5EAA			X	X		X	X	X	X	X	X
	G5F	exc. soil	grab	71BSG5FXAX01XA	BG5FAA			X	X		X	X	X	X	X	X
Composite sample from burn kettle:																
	C5A	0-6	grab	71BSC5AXAX01XA	BC5AAA						X					
			comp	71BSC5AXAX01XA	BC5AAA		X		X			X	X	X	X	X
		18-24	grab	71BSC5BXAX01XA	BC5BAA						#					
			comp	71BSC5BXAX01XA	BC5BAA		O		O			#	#	#	#	#

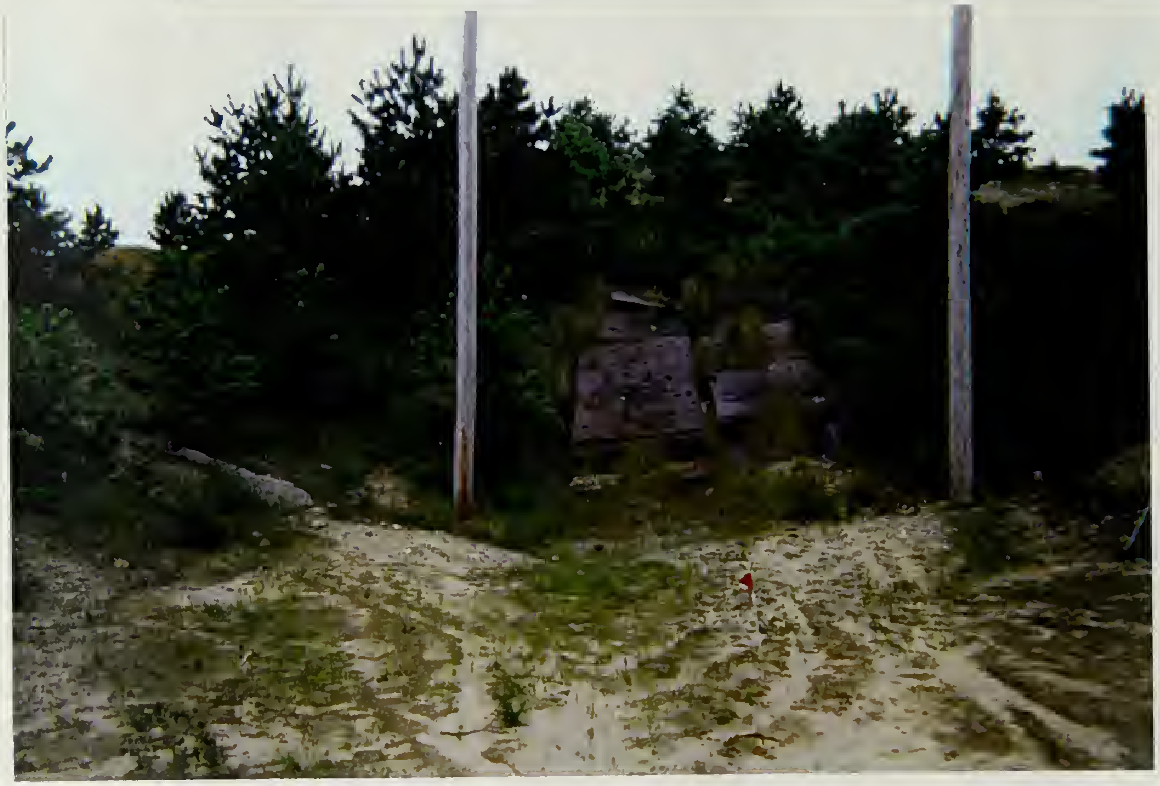
X = to be collected and submitted to laboratory

O = to be collected after the results for the 0-6" sample are received

= to be collected if detected in the 0-6" sample

Photograph A: Bunker near 150-meter range.

Photograph B: Burn kettle near 150-meter range.



Photograph C: Steel plate targets at end of 1000-meter range.

Photograph D: Looking southeast from top of 1000-meter backstop.

Photograph E: Berms to the north of 150-meter backstop.

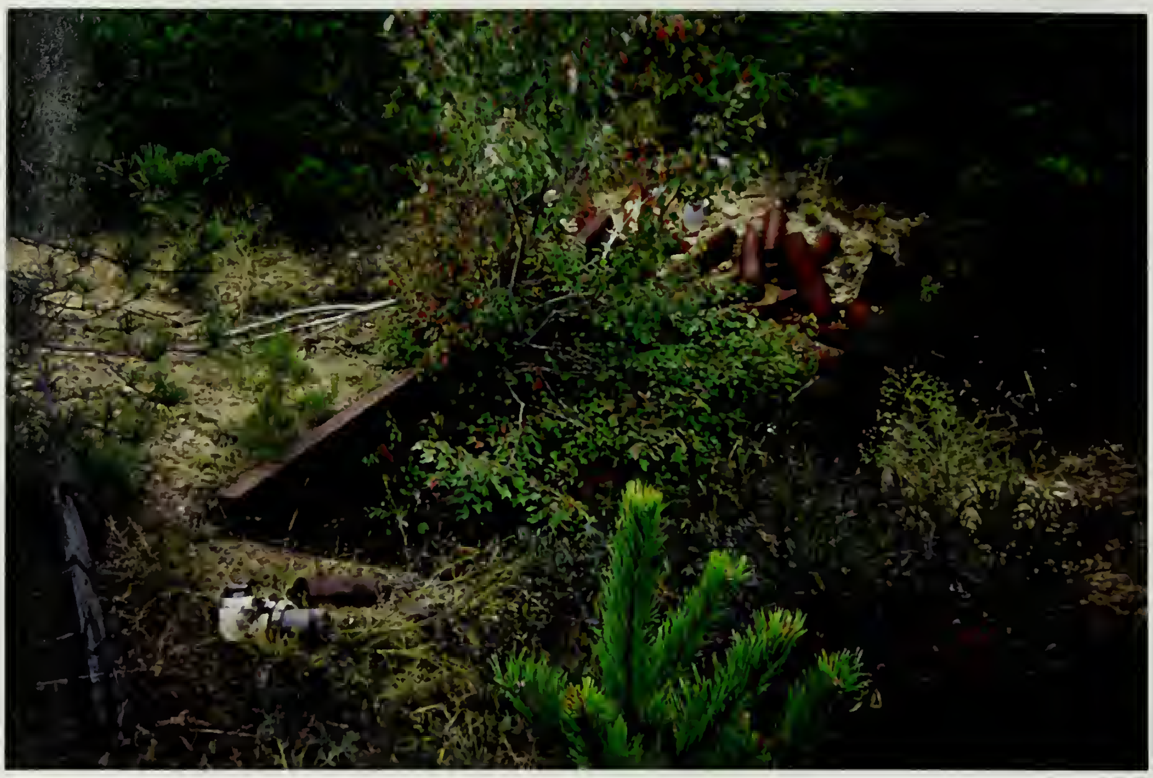
Photograph F: 150-meter range backstop.

Photograph G: Northwest (second) tunnel barrier on 1000-meter range.

Photograph H: SE tunnel barrier on 1000-m range, with steel target on 100-m range.

Photograph I: 10-foot high mound at southeast end of J-1 range.

Photograph J: Cleared area at southeast end of J-1 range.



Photograph K: Steel-sided pit with munitions near the 150-meter backstop.

ATTACHMENT A: FIELD GUIDE TO HIGH EXPLOSIVES

Any substance encountered during sampling activities which differs in any way from natural media will be treated as a dangerous substance, carefully removed from the sample, and set aside.

EXPLOSIVES

NAME	**DESCRIPTION**	**REMARKS**
BLACK POWDER	BROWN TO BLACK	MANUFACTURED IN GRAINS THAT RANGE IN SIZE FROM SMALLER THAN SALT GRAINS TO GRAINS AS LARGE AS SMALL PEBBLES. HIGHLY SENSITIVE TO IGNITION BY HEAT, FRICTION, FLAME, SPARK. WHEN WET, IT IS CORROSIVE TO MOST METALS.
TNT	LIGHT YELLOW TO BROWN OR GRAY	LIGHTLY CORROSIVE WITH LEAD. USED IN BOMBS, GRENADES, DEMOLITION CHARGES, PROJECTILES. EXUDES AT ELEVATED TEMPERATURES. MODERATELY TOXIC BY SKIN ABSORPTION OR INHALATION.
EXPLOSIVE D	BRIGHT YELLOW TO ORANGE. ALSO CALLED AMMONIUM PICRATE.	RELATIVELY INSENSITIVE. HIGHLY TOXIC BY INHALATION, INGESTION, OR SKIN ABSORPTION
AMATOL	LIGHT BROWN TO YELLOW/MIXTURE OF TNT AND EXPLOSIVE D	SLIGHT HYGROSCOPIC. HAS CORROSIVE EFFECTS ON COPPER, BRONZE, LEAD, BRASS. HIGHLY TOXIC BY INHALATION, SKIN CONTACT, INGESTION.
COMPOSITION B	WHITE TO BROWNISH YELLOW, MIXTURE OF TNT AND EXPLOSIVE D	SLIGHTLY CORRODES COPPER, BRASS, CADMIUM, ZINC. USED IN BOMBS, PROJECTILES, GRENADES, SHAPED CHARGES.
OCTOL	LIGHT BROWN	USED IN BOMBS, PROJECTILES, SHAPED CHARGES.
RDX	WHITE. ALSO CALLED CYCLONITE	SENSITIVE TO IMPACT AND FRICTION.SLIGHTLY CORROSIVE WITH COPPER, BRASS, MILD STEEL, CADMIUM. MODERATELY TOXIC BY INHALATION OR INGESTION.
HMX	WHITE. ALSO CALLED OCTOGEN	SENSITIVE TO IMPACT AND FRICTION. SLIGHTLY TOXIC.
PETN	WHITE	SENSITIVE TO IMPACT. SLIGHTLY CORROSIVE TO BRASS, CADMIUM, ZINC. VERY SLIGHTLY TOXIC.

EXPLOSIVES, continued

NAME	DESCRIPTION	REMARKS
LEAD AZIDE	WHITE TO LIGHT BROWN	VERY SENSITIVE TO IMPACT, FRICTION, SPARKS. CORROSIVE TO COPPER, ZINC. VERY SLIGHTLY TOXIC.
LEAD STYPHNATE	LIGHT ORANGE TO REDDISH BROWN	SAME AS LEAD AZIDE.
MERCURY FULMINATE	GRAYISH	VERY SENSITIVE TO IMPACT, FRICTION, SPARKS. CORROSIVE TO ALUMINUM, MAGNESIUM, BRONZE, COPPER, ZINC, BRASS. HIGHLY TOXIC THROUGH SKIN ABSORPTION, INHALATION, INGESTION. SYMPTOMS RESEMBLE MERCURY POISONING.

PYROTECHNIC AGENTS USED AT MMR

SYMBOL	COMMON NAME	VISUAL IDENTIFICATION	ACTION
CS	NONE	WHITE CRYSTALLINE SOLID	TEAR AGENT
HC	HEXACHORO-ETHANE	WHITE SOLID	SCREENING SMOKE
WP	WHITE PHOSPHOROUS	PALE YELLOW SOLID	SCREEN SMOKE AND INCENDIARY
RP	RED PHOSPHOROUS	REDDISH BROWN POWDER	SCREENING SMOKE

OTHER COMPOUNDS

NAME	PROPERTIES	STABILITY
Picric Acid	lemon-yellow crystalline solid	very sensitive to blows or friction
Tetryl	fine yellow crystalline powder	sensitive to blows or friction
Composition A	unknown	unknown
Composition C3	unknown	unknown
Composition C4	unknown	unknown
Pentolite (50/50)	unknown	unknown
Tracer Compound	unknown	unknown
PBX	unknown	unknown
Ednatol	unknown	unknown
Tetrytol	unknown	unknown

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